October 26, 2014

Robert Bosch LLC
4005 Miranda Avenue
Palo Alto, CA 943044
Telephone +1(650)8522241
Marcellino.Gemelli@
us.bosch.com
www.Bosch.us

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554
{Electronic Submission}

In the Matter of
Wireless E911 Location Accuracy)
Requirements) PS Docket No. 07-114

Further Comments of Bosch Sensortec

Bosch Sensortec ("Bosch") submits the following additional informational comments addressing certain technical questions detailed in the Federal Communications Commission's Third Further Notice of Proposed Rulemaking ("FNPRM").[i] Bosch Sensortec was founded in early 2005 and is a subsidiary of Robert Bosch GmbH.[ii] The Company offers micro-mechanical sensors, application and foundry service for consumer electronics, security systems and logistics.

The FCC's FNPRM on wireless location accuracy for E911 seeks input on the determination of altitude in a mobile device through the use of barometric pressure sensors, or by other means.[iii] Bosch reiterates the previous comment from May 12th 2014 where Bosch believes that the current state of the art in barometric pressure sensors will allow for altitude determination of equipped mobile devices to within 3 meter accuracy for at least 67 percent of calls within three years, and for at least 80 percent of calls within 5 years.[iv]

New market study data from IHS iSuppli[v] have shown a marked increase of adoption of pressure sensors in consumer electronics, now forecasting approximately

365 million sensors sold in 2014 primarily to smartphones and tablet computers,. The volume is expected to more than double in 2016 where HIS iSuppli forecasts approximately 713 million pieces sold. The main drivers of this volume increase is the adoption of pressure sensors by flagship phones – such as Apple's recently announced iPhone 6 – as well as a growing adoption in mid-tiered mobile devices such as HTC's Butterfly phone and Nexus 9 tablet.

Such increased availability of barometers is spurring software developers to write apps for Android and iOS that leverage such sensors. Bosch Sensortec is studying an app for mobile devices that calculates the altitude above sea level out of the reading of the built-in pressure sensor and the sea level pressure reference that is obtained from the nearest weather station. Tests have shown an altitude resolution of +/-1m, largely dependent on the distance from the weather station (airport, school, etc.). Such resolution is already compatible to the FCC's FNPRM targets for E911 location accuracy.

Yours sincerely

Marcellino Gemelli
Director, Robert Bosch LLC

---

[i] Wireless E911 Location Accuracy Requirements, PS Docket No. 07-114, Third Further Notice of Proposed Rulemaking, FCC 14-13 (Feb. 20, 2014) ("*FNPRM*").

[ii] Bosch Group comprises Robert Bosch GmbH and its roughly 360 subsidiaries and regional companies in some 50 countries.

[iii] See Paragraphs 25 and 75 of the FNPRM.

[iv] See Paragraph 3 of the 3 FNPRM.

[v] See IHS Technology's MEMS Market Tracker – need subscription

Altitude Content Provider

Bosch Sensortec

Altitude Content Provider
The ACP software (Altitude Content Provider) for mobile devices calculates the altitude above sea level out of the reading of the built-in pressure sensor and the sea level pressure. The sea level pressure reference value can be obtained via internet from nearest weather station.

Background of altimetry

The reading of pressure sensors constitutes of the altitude above sea level and climate conditions. The relation between altitude, pressure sensor reading and sea level pressure reading is

$$\text{altitude}\,[m] = 44330\left(1-\left(\frac{p}{p_0}\right)^{\frac{1}{5.255}}\right)$$

where p is the pressure sensor reading and p_0 = 1013.25 hPa + Δp. The weather influence Δp can be as high as -40 to +20 hPa, corresponding to -340 to +170 m.

Calculating the altitude thus requires the current sea level pressure reference value of the next weather station.

Concept

Hardware input
- BMP180 pressure sensor reading
- Longitude and latitude from GPS position

Internet download
- Sea level pressure reference value measured by weather station nearest to longitude and latitude

Software output
- Altitude above sea level

Features

- Noise-free pressure sensor reading for pleasant display
- Eliminates the influence of weather influences on pressure reading
- Absolute altitude information with a relative accuracy of 1m
- Enables floor detection for in-door navigation
- Noise-free pressure sensor reading for pleasant display
- Provides altitude history (up to 5 hours)
- Generic data format provided

OS platforms and hardware

- Android 2.3 and 3.0
- BMP085 or BMP180

Headquarters
Bosch Sensortec GmbH

Gerhard-Kindler-Strasse 8
72770 Reutlingen · Germany
Telephone +49 7121 3535 900
Fax +49 7121 3535 909
contact@bosch-sensortec.com
www.bosch-sensortec.com

Data & Specification subject to change without notice
Doc.-Number: BST-BMP180-FL000-02 / Version_1.0_082011